AD NUMBER
AD802199
NEW LIMITATION CHANGE
TO **Approved for public release, distribution unlimited**
FROM **Distribution authorized to U.S. Gov't. agencies and their contractors; Critical Technology; 02 JUN 1958. Other requests shall be referred to Space and Missile Systems Organization, Los Angeles, CA.**
AUTHORITY
SAMSO USAF ltr, 28 Feb 1972

AD802199

EVALUATION TEST OF NORMALLY OPEN SQUIB VALVE,

LOCKHEED MISSILES AND SPACE CO INC SUNNYVALE CA

02 JUN 1958

EVALUATION TEST OF NORMALLY OPEN SQUIB VALVE

TEST LABORATORIES DEPT. (51-62)

MECHANICAL AND FLUID DYNAMICS GROUP

REFERENCE: TA 1652

MODEL: WS117L

SUBMITTED UNDER: AF 04(647)-97

CHARGE: 3-6002-8769-10

DATE: 2 June 1958

REQUESTED BY: XA Vehicle Dept. Propulsion Group

PREPARED BY: D. E. Ehrlich
D. E. Ehrlich

APPROVED BY: F. A. Martin
F. A. Martin
Acting Group Engr.

R C Geiger
R. C. Geiger
Section Engineer

OBJECTIVE

The purpose of this investigation was to evaluate the Futurecraft normally open, squib operated valve, part number 30118, under specific environmental conditions including proof, leakage, temperature, vibration, acceleration, corrosion, and cycle tests.

CONCLUSION

This valve performed satisfactorily under all test conditions to which it was subjected, as specified in Reference 1. The poppet with "O" rings installed, was a force fit within the valve body, in both the open and actuated (closed) positions, and it exhibited no tendency to loosen during the vibration and acceleration tests. Similarly, the component survived internal and external corrosion testing, and cycle testing; in no instance was leakage in evidence. However, one possible limiting factor -- galling and seizing of external body threads, following external exposure to IRFNA fumes -- might affect valve reusability. (See "Discussion")

TEST SPECIMEN

The test specimen was a normally open squib operated valve manufactured by Futurecraft Corporation, El Monte, California. The valve was identified by

Futurecraft part number 30118, serial number 101, and Lockheed part number 1060689. (See Figures 1 and 3.)

The test article has been scheduled for two different applications in the pressurization system: (1) closure of a 3/8 inch vent line leading from the fuel tank; (2) closure of a 1/2 inch vent line leading from the oxidizer tank. Except for end fitting sizes, the valves for these applications are identical. Since the internal environment will be different for each [illegible]ation, corrosion testing was conducted as if two separate parts were under test.

Normally the valves will be open but will close by firing the squib upon the command of a programmed signal. Prior to closing, the 1/2 inch valve is internally exposed to helium gas containing IRFNA vapor, and the 3/8 inch valve is internally exposed to helium gas containing JP-4 fuel vapor. The valves are designed to actuate at zero ambient pressure and to have minimum leakage after closure.

Since only one specimen was available for testing, it was subjected to the most severe corrosion condition which was judged to be the IRFNA exposure.

TEST EQUIPMENT AND INSTRUMENTATION

The following equipment was used while conducting the test.

1. Low pressure regulated helium supply system.
2. Grieve-Hendry Oven, 150°F to 550°F (LMSD No. 18353).
3. Calidyne 1250-pound shaker (LMSD No. 13474).
4. Centrifuge, 25g (LMSD No. 44438).
5. Oscillograph (LMSD No. 15812).
6. Beckman Helium Leak Detector - mass spectrometer type (LMSD No. 24656).
7. Miscellaneous gages, plumbing, fixtures, etc.

PROCEDURE AND RESULTS

1. Inspection.
   a. Procedure: The valve was disassembled, visually inspected, and reassembled.
   b. Results: No defects were noted and the part was not contaminated. The poppet with "O" rings installed was a force fit within the valve body and had to be driven out during disassembly and then pressed in during reassembly.

2. Proof Test.

   a. Procedure: The outlet port was capped, and 160 psig helium was applied to the inlet port. The valve was then submerged in water while pressurized.

   b. Results: No visible leakage nor structural failure was in evidence.

3. Leakage and Temperature Test.

   a. Procedure: The squib was installed in the valve, and external leakage was checked with a mass spectrometer type leak detector after application of 80 psig helium to the inlet port with the outlet port capped. First, the test was conducted at ambient temperature with the valve open; then, it was conducted at 200°F after a 5-minute soak period, with the valve open. Next, after an additional 5-minute soak at 200°F the valve was closed by firing the squib. Internal leakage was checked by connecting a bubbler to the outlet port and applying 80 psig helium to the inlet port. Leakage was additionally checked after cooling to ambient temperature (70°F).

   b. Results: In each of the individual tests above, no evidence of leakage was detected, nor was any damage to the specimen from the squib firing observed. (See Figure 1.)

4. Vibration.

   a. Procedure: The valve was attached to a test fixture which in turn was mounted on a Calidyne shaker. After the outlet port was capped, a live squib was installed in the valve, and 80 psig helium was then applied to the inlet port. The valve was next subjected to vibration frequencies between 10 and 85 cps under an increasing acceleration from 1 to 10g at a linear rate, and between 85 to 2000 cps with constant acceleration at 10g. External leakage was checked during vibration by means of a mass spectrometer type helium leak detector. Vibration was applied for eight minutes along the axis of the poppet and for eight minutes perpendicular to the axis of the poppet. The squib was then fired, closing the valve, and the test repeated as above, except that a bubbler was attached to the outlet port, for internal leakage observation. (See Figure 2 for squib firing circuitry).

   b. Results: No leakage was detected during these tests.

5. Acceleration Test.

a. Procedure: The valve with the poppet in the actuated (closed) position was subjected to 12g acceleration with the force directed separately (1) to open the valve, (2) to close the valve, and (3) perpendicular to the poppet axis. Internal leakage was checked during acceleration by applying 80 psig helium to the inlet port and attaching a rubber balloon to the outlet port for leakage accumulation.

b. Results: No leakage was in evidence during the entire test.

6. Internal Corrosion Test.

a. Procedure: The valve was exposed to IRFNA fumes internally for seven days with the poppet in the open position. After a water rinse, the valve was closed by firing a squib, and internal leakage was checked with 80 psig helium applied to the inlet port and a bubbler attached to the outlet port.

b. Results: The valve closed properly after exposure to acid fumes. No leakage was observed with the valve in the actuated position.

7. Cycle Test.

a. Procedure: External leakage with the valve in the open position was checked with a mass spectrometer type leak detector while applying 80 psig helium to the inlet port with the outlet port capped. The valve was closed by firing a squib, and internal leakage was checked by applying 80 psig to the inlet port with a bubbler attached to the outlet port. The valve was then disassembled, cleaned, and recharged. This procedure was repeated five consecutive times. Squib response times were also recorded on an oscillograph.

b. Results: (tabular)

CYCLE TEST DATA

Cycle Number	Squib Firing Current (Amperes)	Total Time Firing Squib (Seconds)	Condition	Inlet Pressure (psig helium)	Leakage
1	1.54	.00252	Valve Open	80	None
			Valve Closed	80	None
2	1.45	.00325	Valve Open	80	None
			Valve Closed	80	None
3	1.49	.00301	Valve Open	80	None
			Valve Closed	80	None
4	1.50	.00684	Valve Open	80	None
			Valve Closed	80	None
5	1.42	.00302	Valve Open	80	None
			Valve Closed	80	None

8. External Corrosion Test.

   a. Procedure: The valve was subjected to IRFNA fumes externally for 48 hours with the inlet and outlet ports capped and an expended squib installed. The valve was then rinsed with water, and external leakage checked with a mass spectrometer type leak detector. Next, the valve was armed, then closed by firing the squib, and internal leakage checked.

   b. Results: The valve was in good condition after the acid fumes exposure, with no evidence of external or internal leakage. However, during disassembly the external body threads of the valve galled and seized, thereby rendering the parts unfit for subsequent use. (Figure 3). Also, the expended M-79 squib, which was installed in the valve for the external exposure portion of the test, was rusted due to partial deterioration of the squib protective coating.

DISCUSSION

Only one valve was available instead of the two called for by Reference 1. Consequently it was necessary to forego that portion of the requirement asking for JP-4 fuel internal exposure. Conducting the cycle test between the internal and external corrosion tests was simply a matter of laboratory convenience.

The galling and seizing of the valve external body threads was presumably caused by the action of IRFNA fumes which diffused between the threads. The anodized coating had been partially removed from the threads during seven previous disassembly operations. The first two threads had been dressed with a small file to remove several slight nicks and dents induced during the disassembly procedures. This galling and seizing, attributable to the presence of IRFNA fumes, might be prevented by the application of an IRFNA-resistant lubricant on the valve threads.

REFERENCES

1. XA Weapons System Branch Job Request 2-0251, dated 11 November 1957; Revision No. 1, 4 February 1958.

2. Defect Report No. 30, 5 May 1958, Futurecraft Normally Open Squib Valve.

3. Interoffice Notebook Pages Numbered 14864-14866, 14871, 14873, 14875-14876.

4. Data relative to this test was transmitted to the cognizant department by 20 May 1958.

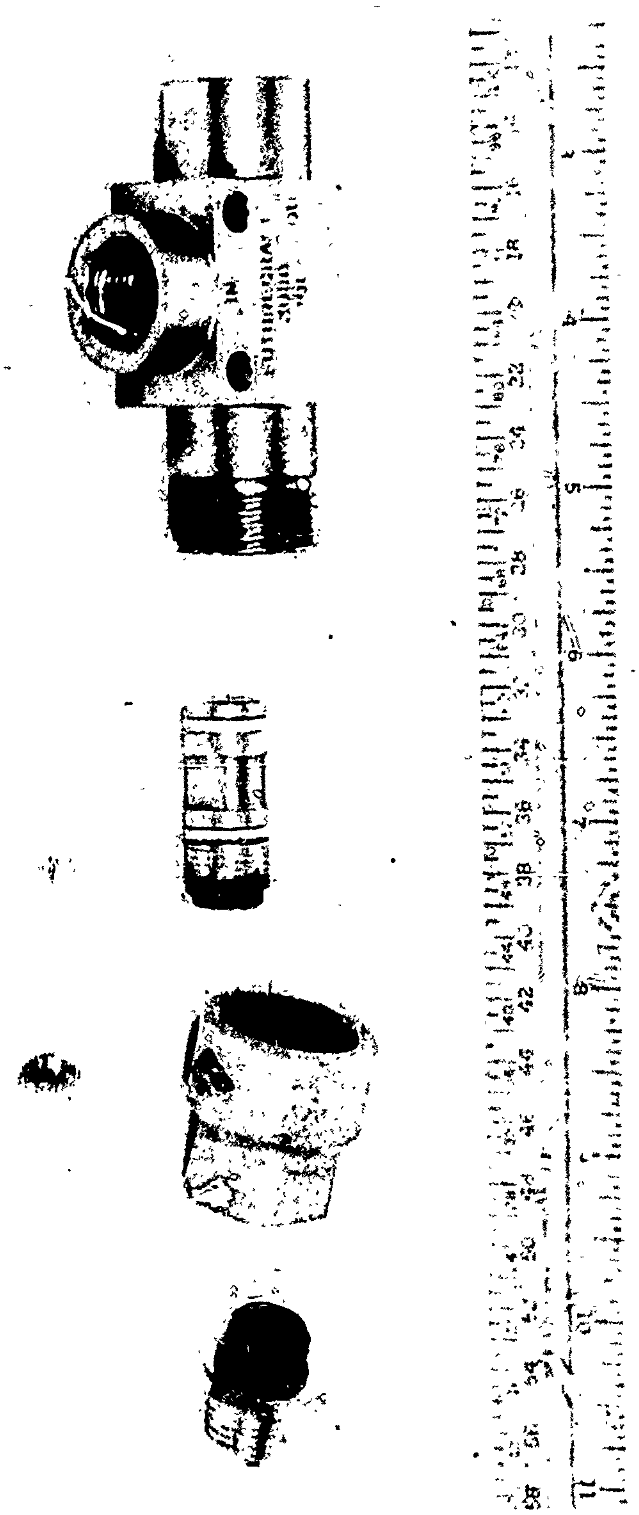

FIGURE 1. Exploded View - Valve and Squib After Temperature and Firing Tests

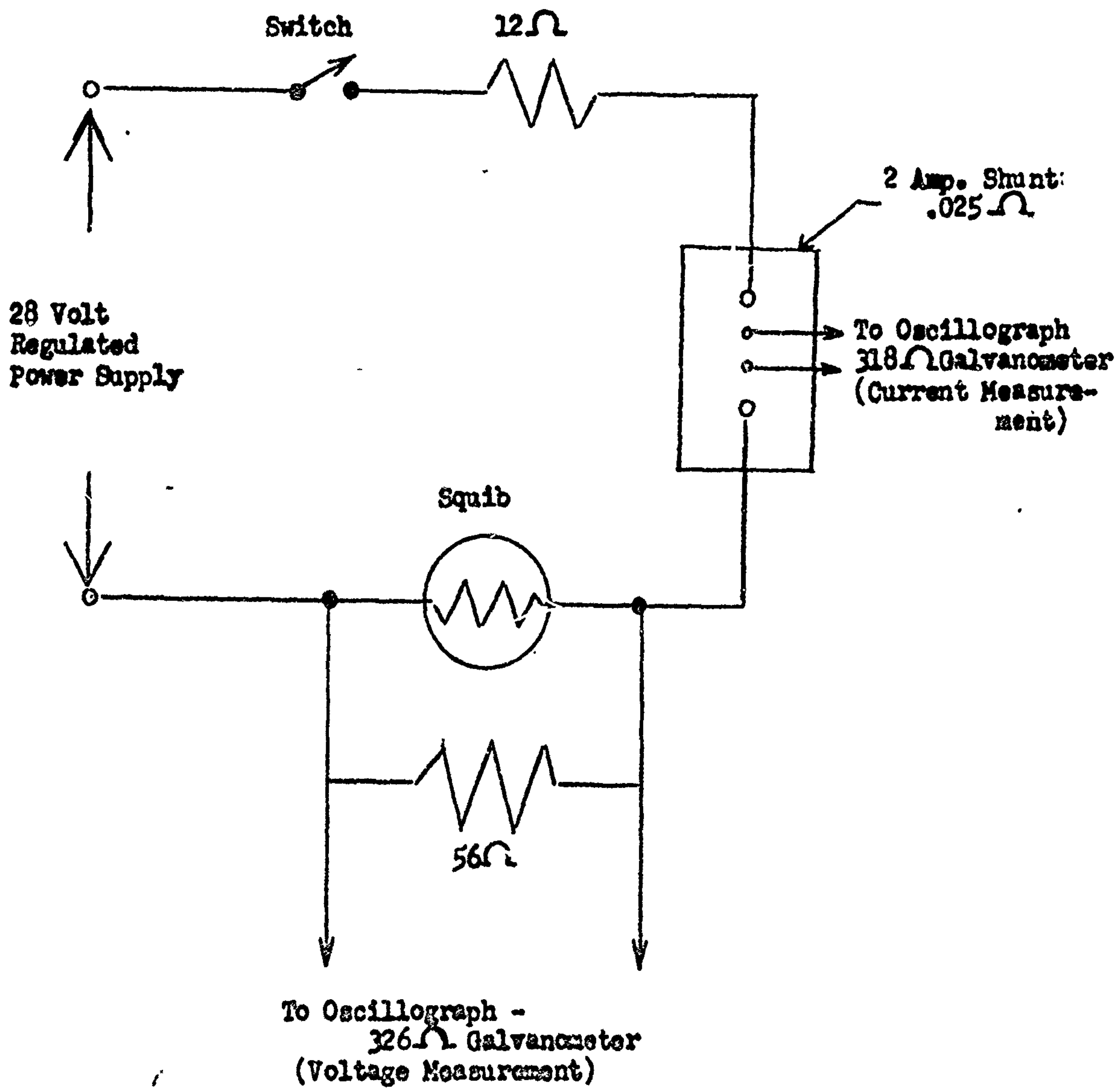

FIGURE 2. Squib Firing Circuit

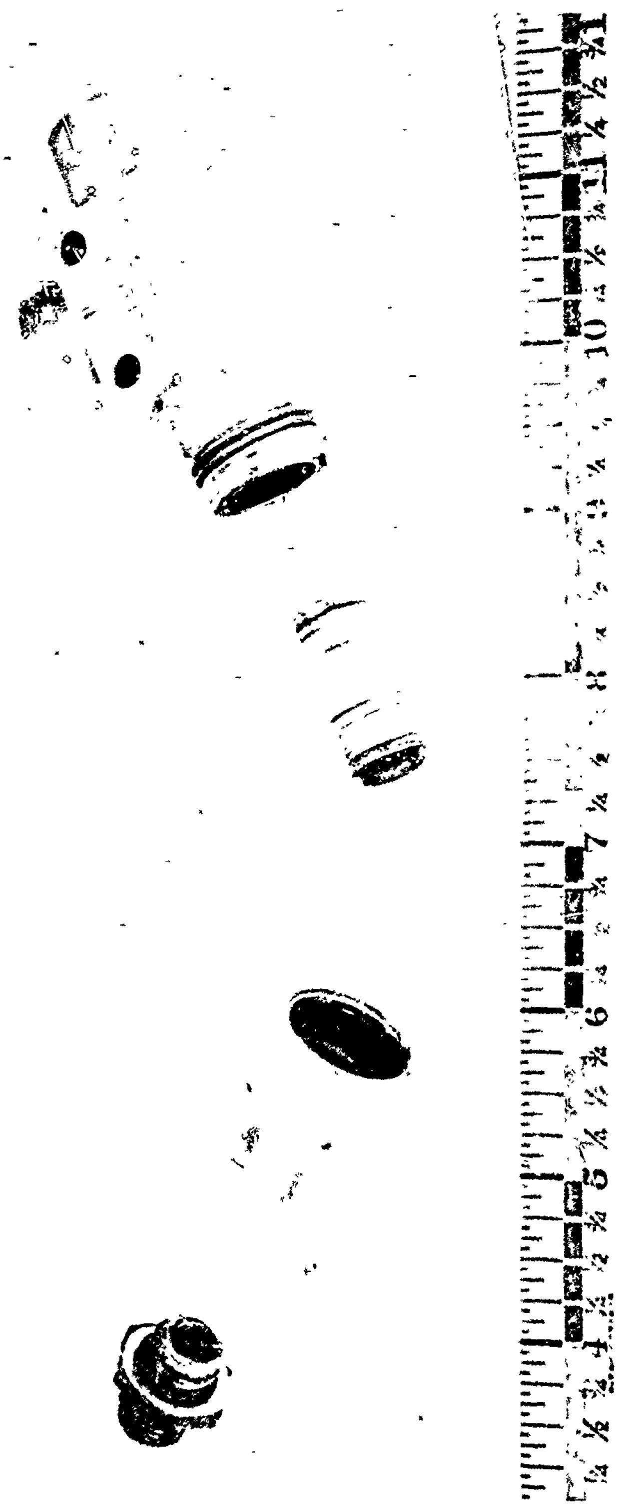

FIGURE 3. Galled Threads of Disassembled Valve Following External Exposure to IRFNA